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(54) TECHNIQUES FOR BOOTING AN INFORMATION PROCESSING SYSTEM

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(22) Filed: **Jun. 10, 2014**

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(30) **Foreign Application Priority Data**

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(51) **Int. Cl.**
G06F 15/177 (2006.01)
G06F 9/44 (2006.01)

(52) **U.S. Cl.**
CPC ***G06F 9/4401*** (2013.01)

(58) **Field of Classification Search**
CPC G06F 15/177; H04N 7/16; H04L 9/00; H04L 9/32
USPC 713/1, 2
See application file for complete search history.

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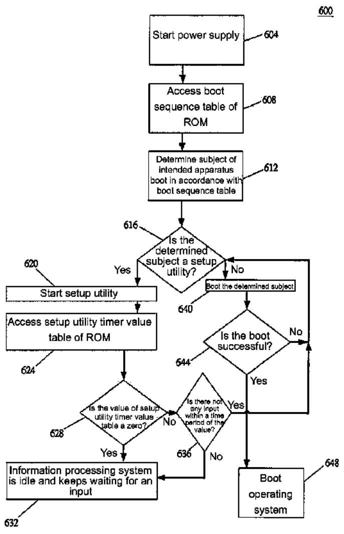
(57) ABSTRACT

A technique for booting an information processing system includes storing a boot sequence table in a storage unit. The boot sequence table includes a specific boot sequence defining a boot sequence of a setup utility and a bootable subject during booting. The boot sequence table is accessed via the operating system firmware interface. A subject to be booted is determined in accordance with the boot sequence.

10 Claims, 4 Drawing Sheets


600
Start power supply
604
Access boot sequence table of ROM
608
Determine subject of intended apparatus boot in accordance with boot sequence table
612
616
Is the determined subject a setup utility?
Yes
No
620
Start setup utility
Boot the determined subject
640
Access setup utility timer value table of ROM
624
Is the boot successful?
644
No
Yes
Is the value of setup utility timer value table a zero?
628
No
Is there not any input within a time period of the value?
Yes
636
No
Yes
Information processing system is idle and keeps waiting for an input
632
Boot operating system
648

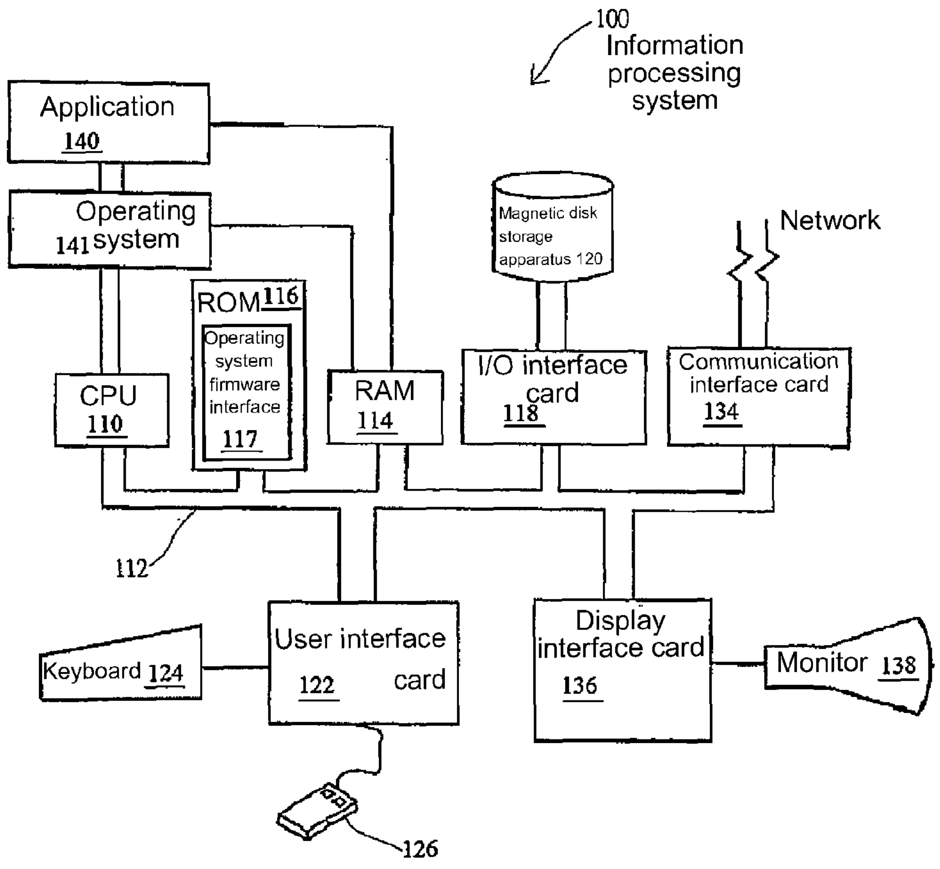

100
Information processing system
Application 140
Operating system 141
ROM 116
Operating system firmware interface 117
CPU 110
RAM 114
Magnetic disk storage apparatus 120
I/O interface card 118
Network
Communication interface card 134
112
User interface card 122
Keyboard 124
Display interface card 136
Monitor 138
126

FIG.1

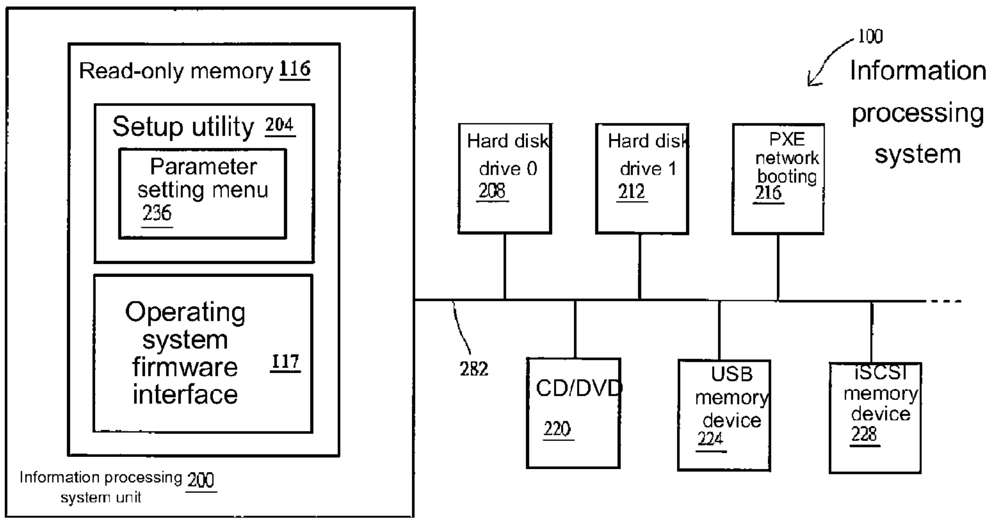

100
Information processing system
Read-only memory 116
Setup utility 204
Parameter setting menu 236
Operating system firmware interface 117
Information processing system unit 200
Hard disk drive 0 208
Hard disk drive 1 212
PXE network booting 216
282
CD/DVD 220
USB memory device 224
iSCSI memory device 228

FIG.2

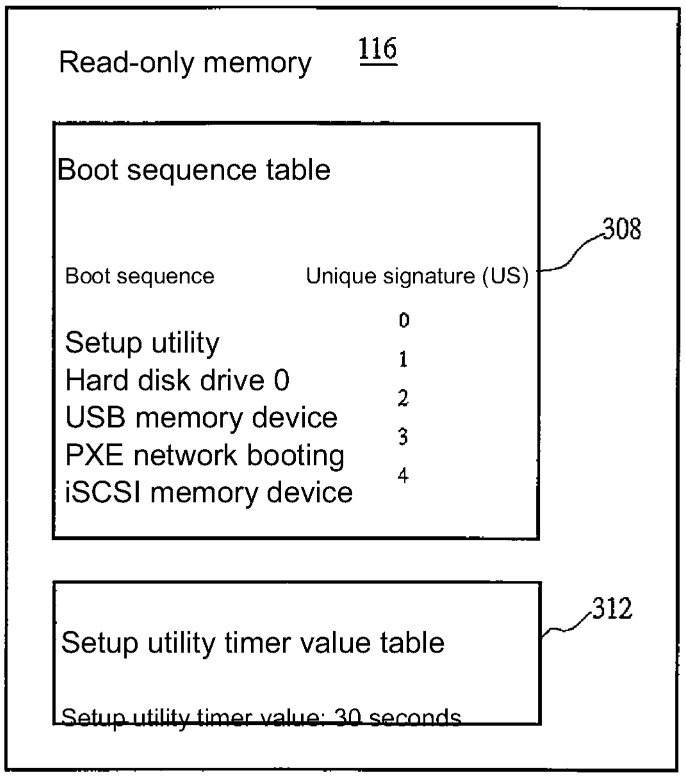

Read-only memory 116
Boot sequence table
308
Boot sequence
Unique signature (US)
Setup utility 0
Hard disk drive 0 1
USB memory device 2
PXE network booting 3
iSCSI memory device 4
Setup utility timer value table
312
Setup utility timer value: 30 seconds

FIG.3

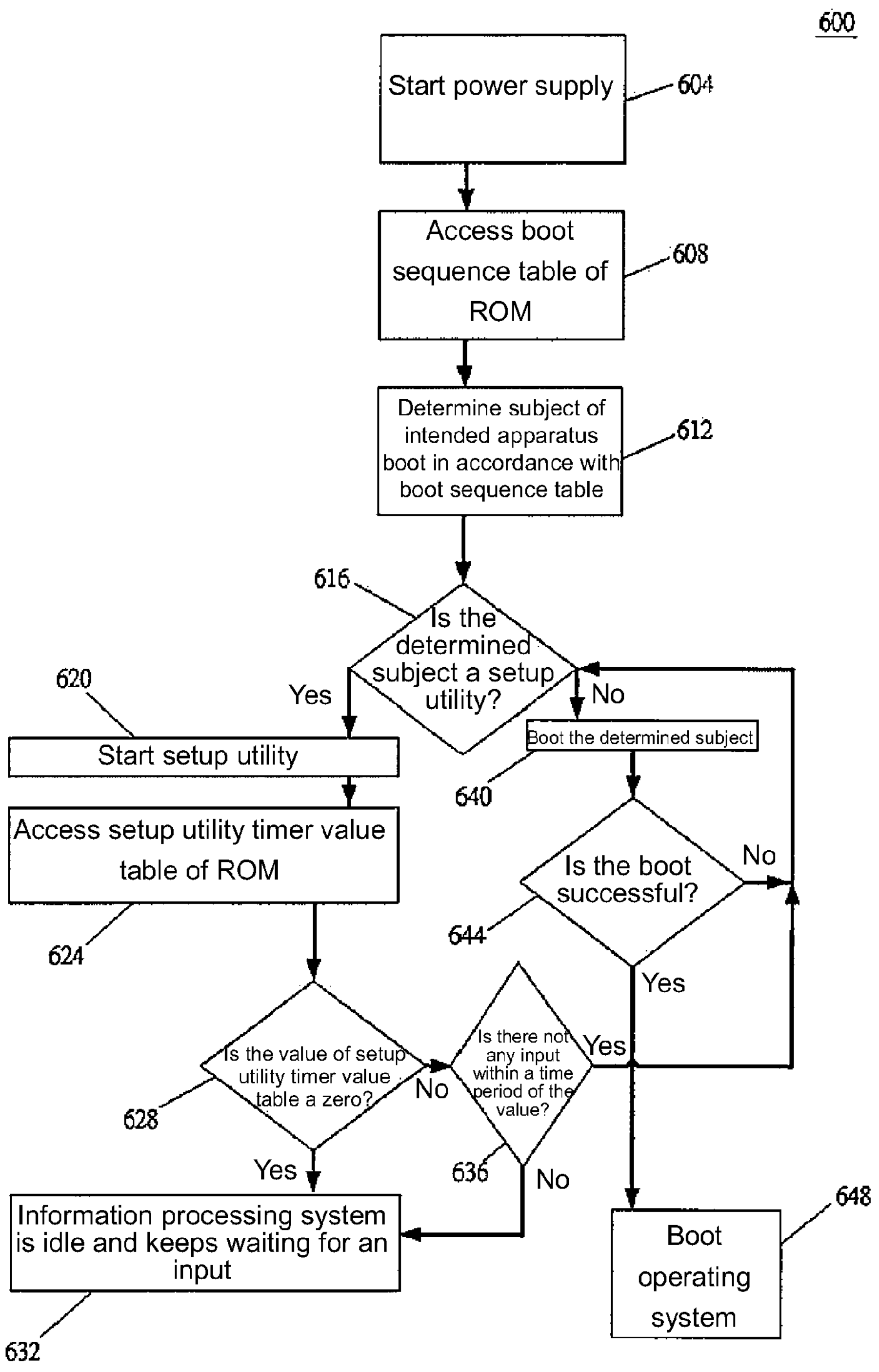

600
Start power supply
604
Access boot sequence table of ROM
608
Determine subject of intended apparatus boot in accordance with boot sequence table
612
616
Is the determined subject a setup utility?
Yes
No
620
Start setup utility
Boot the determined subject
640
Access setup utility timer value table of ROM
624
Is the boot successful?
No
644
Yes
Is the value of setup utility timer value table a zero?
628
No
Is there not any input within a time period of the value?
Yes
636
No
Yes
Information processing system is idle and keeps waiting for an input
632
Boot operating system
648

FIG.4

TECHNIQUES FOR BOOTING AN INFORMATION PROCESSING SYSTEM

This application claims priority to Taiwanese Patent Application 102120654, entitled "METHOD, APPARATUS, AND COMPUTER PROGRAM PRODUCT FOR BOOTING AN INFORMATION PROCESSING SYSTEM." filed on Jun. 11, 2013. The disclosure of Taiwanese Patent Application 102120654 is hereby incorporated herein by reference in its entirety for all purposes.

BACKGROUND

The disclosure relates to an information processing system and, more specifically, to techniques for booting an information processing system.

Computer systems are in wide use in various areas nowadays to enable robust computation. A typical computer system (i.e., an information processing system) has a central processing unit (CPU) and related volatile/non-volatile memory, including a random access memory (RAM) and a read-only memory (ROM), such as a flash memory, with a basic input/output system (BIOS). The electrical coupling of the aforesaid components and the like is achieved by a motherboard or any other appropriate means.

During a boot of an information processing system, BIOS routines usually initialize hardware, test hardware functions, and guide the actions of an operating system. BIOS routines are always executed as soon as a boot begins. Unless BIOS routines are executed full and well, some hardware components will not function well and thus will require troubleshooting before they can continue with their operation. Conventionally, a BIOS setup utility serves to set the configuration and functions of the system and the values set by BIOS setup utility are then stored in a CMOS chip to provide reference for use in system configuration analysis and testing. Furthermore, BIOS service routines come in the form of commonly known BIOS interruption service routines and most hardware access operations are performed by the BIOS interruption service.

Conventionally, BIOS parameters are usually set and changed by executing a BIOS setup utility in the BIOS chip and the execution of BIOS setup utility begins as soon as a user presses one or more related function keys. To enter a BIOS setup utility, the user has to wait for a while first and then press related function keys to begin performing various setting processes (boot sequencing, performance tuning, etc.) as soon as a prompt message (e.g., "press function key to enter BIOS Setup") pops into view. However, the display of the prompt message may last for only several seconds. If the user misses the prompt message, the user will have to reboot the system in order to enter the BIOS setup utility again.

In an attempt to change the BIOS settings, which might require a large number of instances of reboot, the user is likely to omit pressing or forget to press some function keys during a boot (e.g., the user may not press some function keys because the user leaves the scene before the boot is done).

If the system cannot be booted in accordance with a predefined boot path for a specific reason (for example, hard disk drive **0**, which is booted first, ends up in a failure), the user can only discover that the screen shows simple text or images descriptive of the related failure, but the user still has to reboot BIOS setup utility in order to dig into its actual details and situation.

In fact, according to the conventional art, the user often has to anticipate a prompt message and wait for the time to press function keys before the expected entry into BIOS setup

occurs. The aforesaid problems may necessitate a large number of instances of rebooting a BIOS setup utility, cause a waste of time, bring inconvenience to users, and mainly account for low efficiency.

BRIEF SUMMARY

A technique for booting an information processing system includes storing a boot sequence table in a storage unit. The boot sequence table includes a specific boot sequence defining a boot sequence of a setup utility and a bootable subject during booting. The boot sequence table is accessed via the operating system firmware interface. A subject to be booted is determined in accordance with the boot sequence.

The above summary contains simplifications, generalizations and omissions of detail and is not intended as a comprehensive description of the claimed subject matter but, rather, is intended to provide a brief overview of some of the functionality associated therewith. Other systems, methods, functionality, features and advantages of the claimed subject matter will be or will become apparent to one with skill in the art upon examination of the following figures and detailed written description.

The above as well as additional objectives, features, and advantages of the present invention will become apparent in the following detailed written description.

BRIEF DESCRIPTION OF THE DRAWINGS

The description of the illustrative embodiments is to be read in conjunction with the accompanying drawings, wherein:

FIG. **1** is a schematic view of an information processing system according to an embodiment of the present disclosure;

FIG. **2** is a schematic block diagram of the information processing system according to one embodiment of the present disclosure;

FIG. **3** is a schematic block diagram of a ROM according to an embodiment of the present disclosure; and

FIG. **4** is a flow chart of a booting method according to an embodiment of the present disclosure.

DETAILED DESCRIPTION

The illustrative embodiments provide a method, an apparatus, and a computer program product for retrieval of an image having high similarity to an acquired image, from among a plurality of stored images.

In the following detailed description of exemplary embodiments of the invention, specific exemplary embodiments in which the invention may be practiced are described in sufficient detail to enable those skilled in the art to practice the invention, and it is to be understood that other embodiments may be utilized and that logical, architectural, programmatic, mechanical, electrical and other changes may be made without departing from the spirit or scope of the present invention. The following detailed description is, therefore, not to be taken in a limiting sense, and the scope of the present invention is defined by the appended claims and equivalents thereof.

It should be understood that the use of specific component, device, and/or parameter names are for example only and not meant to imply any limitations on the invention. The invention may thus be implemented with different nomenclature/terminology utilized to describe the components/devices/parameters herein, without limitation. Each term utilized herein is to be given its broadest interpretation given the context in which that term is utilized. As may be used herein, the term 'coupled' may encompass a direct connection between components or elements or an indirect connection between components or elements utilizing one or more intervening components or elements.

The disclosure provides an information processing system booting technique which is user-friendly and conducive to great reduction in the number of instances of rebooting s BIOS setup utility.

The disclosure provides, in an illustrative embodiment thereof, a method for booting an information processing system. The information processing system comprises a central processing unit (CPU) or processor, a storage unit, and at least a bootable subject. The bootable subject is electrically coupled to the CPU and the storage unit. The storage unit includes an operating system firmware interface and a setup utility. The method comprises: storing a boot sequence table in the storage unit, wherein the boot sequence table includes a specific boot sequence defining a boot sequence of the setup utility and the at least a bootable subject during booting; accessing, by the CPU, the boot sequence table via the operating system firmware interface; and determining, by the CPU, a subject to be booted in accordance with the boot sequence.

The method may further comprise: determining whether the subject to be booted is the setup utility; starting the setup utility in response to the determining that the subject is the setup utility; and starting the bootable subject in response to the determining that the subject is not the setup utility.

The method may further comprise: storing a setup utility timer value table in the storage unit, wherein the setup utility timer value includes a specific time value; and accessing, by the CPU, the setup utility timer value table via the operating system firmware interface.

The method may further comprise keeping the information processing system idle and waiting for an input from at least a human interface apparatus in response to the accessed specific time value being zero.

The method may further comprise: determining whether there is not any input from the at least a human interface apparatus within a specific time period of the value in response to the accessed specific time value being not zero; keeping the information processing system idle and waiting for an input from the at least a human interface apparatus in response to presence of an input from the at least a human interface apparatus; and determining whether the booted subject is the setup utility in response to absence of an input from the at least a human interface apparatus.

The method may further comprise accessing, by the CPU, an instruction from the operating system firmware interface to boot an operating system,

The operating system firmware interface may include a basic input/output system (BIOS), a universal extensible firmware interface (UEFI), or an extensible firmware interface (EFI). The bootable subject may comprise a hard disk drive **0**, a hard disk drive **1**, a preboot execution environment (PXE) network booting, a compact disc/digital versatile disk (CD/DVD), a universal serial bus (USB) memory device, and an Internet small computer system interface (iSCSI) memory device.

The disclosure provides, in another illustrative embodiment, a computer program product having a computer-readable program stored on a computer-readable storage device. When executed by an information processing system, the computer-readable program enables the information processing system to implement the previously described method, operations, and a combination thereof as described in the illustrative embodiments.

The disclosure provides, in yet another illustrative embodiment thereof, an apparatus for booting an information processing system. The apparatus comprises: a CPU; a storage unit electrically coupled to the CPU and comprising an operating system firmware interface and a setup utility; at least a bootable subject electrically coupled to the CPU and the storage unit; and a boot sequence table stored in the storage unit. The boot sequence table includes a specific boot sequence defining a boot sequence of the setup utility and the bootable subject during booting. The CPU accesses the boot sequence table via the operating system firmware interface and determines a subject to be booted in accordance with the boot sequence table.

Referring to FIG. **1**, there is shown a schematic view of the hardware framework of an information processing system **100** according to an embodiment of the present disclosure. The information processing system **100** comprises a central processing unit (CPU) or processor **110** connected to other components by a system bus **112**. An operating system **141** run on the CPU **110** is executable to control and coordinate the functioning of the components shown in FIG. **1**. The operating system **141**, which is commercially available, can be exemplified by Microsoft™ Windows™ (wherein Microsoft™ and Windows are are trademarks owned by Microsoft and registered in the United States and/or other countries), UNIX, and. AIX.

Under the control of the operating system **141**, applications **140** move into and move out of a main memory **114** (including but not limited to a random access memory, RAM). A storage apparatus **116** (including but not limited to a read-only memory, ROM) is connected to the CPU **110** by the system bus **112**. The ROM **116** comprises an operating system firmware interface **117** which controls basic computer functions. The RAM **114**, an I/O interface card **118**, and a communication interface card **134** are connected directly to the system bus **112**. The I/O interface card **118** is connected to a computer system interface card of a magnetic disk storage apparatus **120** (including but not limited to a hard disk drive). The communication interface card **134** enables the system bus **112**, to be connected to an external network, and enables the information processing system **100** to communicate with another system.

The information processing system **100** receives data from another system and sends data to another system via a network (such as the Internet). Basic input apparatuses, such as a mouse **126** and a keyboard **124**, are connected to the system bus **112** via a user interface card **122**. A display interface card **136** displays images on a monitor **138**. The monitor **138** includes, but is not limited to, a liquid crystal panel or a touch panel. A user operates or clicks on the information processing system **100** with an input apparatus, such as a mouse or a keyboard.

Referring to FIG. **2**, a schematic block diagram of a read-only memory (ROM) **116** (including but not limited to a flash memory) and other components of the information processing system **100** shown in FIG. **1** are further illustrated. The ROM **116** is disposed in an information processing system unit **200** of the information processing system **100**. A hard disk drive **0** (Hard Disk **0**) **208**, a hard disk drive **1 212**, a preboot execution environment (PXE) network booting **216** (that is, preboot execution environment booting is a network-based booting technique which entails booting by means of a network jack of a motherboard, for example), a CD/DVD **220**, a USB memory device **224**, and an iSCSI memory device

228 are connected to the information processing system unit **200** via a bus **282**. Each of the components described above with reference to FIG. **2** are well known to persons skilled in the art and, as such, are not described further herein for the sake of brevity. Details of components of the information processing system **100** and operation thereof are further described below.

In an embodiment, the ROM **116** includes the operating system firmware interface **117**. The operating system firmware interface **117** includes a BIOS, an EFI, a UEFI an may include other interfaces. The ROM **116** further includes a setup utility **204** for setting configuration, functions and the authority of the information processing system **100**.

In various embodiments, taking the BIOS **117** as an example, an instruction required for a standard boot procedure of the information processing system **100** is recorded by a routine. As soon as the power supply of the information processing system **100** starts, the CPU **110** executes a boot in accordance with a booting procedure instruction recorded in the BIOS **117**, including but not limited to testing automatically hardware components on the motherboard (not shown), determining whether the CPU **110**, the ROM **116**, and the RAM **114** are functioning well, searching for the operating system **141** and booting it, and handing the information processing system **100** hardware over to the operating system **141** for a boot, management, and control.

The BIOS **117** is an initial routine for booting a system as soon as power is supplied thereto. The BIOS **117** also preboots the operating system **141** and connects a data stream between apparatuses (such as the hard disk drive **120**, the keyboard **124**, the mouse **126**, and the display interface card **136**). As soon as the system power supply starts, the BIOS **117** performs default value setting and boots a Power-on Self Test (POST).

UEFI resulted from concerted efforts made by industrialists to enhance and improve the booting procedure. In short, UEFI is about an interface rule which sets forth an architecture-oriented independent mechanism for an interface between an operating system and a platform firmware during a boot and supports initialization of add-on cards (such as expansion cards, and adapter cards.) UEFI circumvents intrinsic limitations on a BIOS, manifests optimal expandability, enables new components to be created by a standard programming language tool, supports C language programming, and renders programs easy to maintain.

In general, the operating system firmware interface **117** (including but not limited to BIOS and UEFI) is built in the motherboard of a computer system to control a setting interface for use in basic hardware operation. To adjust an apparatus selected during a boot of the information processing system **100** or after installing a new apparatus on the information processing system **100**, the user performs related setting on the operating system firmware interface **117**, for example, parameter setting of the operating system firmware interface **117**. Take the BIOS **117** as an example, to adjust the sequence of an apparatus (such as a drive) selected during a boot of the information processing system **100** or after installing a new apparatus (such as a drive) on a computer system, the user changes parameters of the BIOS **117**. A typical way of changing BIOS parameters entails executing the setup utility **204** of the BIOS in the ROM **116**.

BIOS parameters are stored in the ROM **116**, but the present invention is not limited thereto. The BIOS parameters include information pertaining to a system CPU, a floppy drive driver, a hard disk drive driver, a monitor, and a keyboard. Typically, BIOS parameter setting is required for testing or delivering the information processing system **100** or adding a component thereto. After it has been shut down, a standby battery (not shown) supplies power to the ROM **116** of the information processing system **100** to enable retention of data stored therein.

In an embodiment, the setup utility **204** includes but is not limited to a parameter setting interface. The operating frame of the parameter setting interface is displayed by the monitor **138**, such that the user can adjust and set the parameters (including but not limited to BIOS parameters) of the parameter setting interface. The CPU **110** is electrically coupled to the monitor **138** and the ROM **116** and adapted to execute the operating system firmware interface **117**, call the parameter setting interface, and display the parameter setting interface on the monitor **138**. Take the BIOS **117** as an example, to enable BIOS parameter setting to be performed, the monitor **138** typically displays a parameter setting interface or setting window of a graphic user interface, but the present invention is not limited thereto. A parameter setting interface or menu **236** displays setting options, such as system standard parameter setting, chip parameter setting, BIOS parameter setting, loading BIOS default value, selecting loading optimal setting value, user password setting, and power management setting, (but the present invention is not limited thereto), such that the user can perform switching and setting by clicking on the setting options or through an input apparatus, such as a mouse or a keyboard.

In one embodiment, the setup utility **204** includes the parameter setting menu **236**. The parameter setting menu **236** includes a plurality of setting options, such that the user adjusts and sets parameter values of the setting options for executing the operating system firmware interface **117** by parameter setting items of the parameter setting menu **236**.

Referring to FIG. **3**, in an embodiment, the ROM **116** further stores a boot sequence table **308** which illustrates the boot sequence of apparatuses connected, the setup utility **204** (that is, treating the setup utility **204** as a bootable subject), and their unique signatures. The setup utility **204** is allocated to whatever sequence and position in the boot sequence table **308** in accordance with the user's setting. Referring again to FIG. **3**, the boot sequence begins with the setup utility **204**, which is followed by the hard disk drive **0 208**, USB memory device **224**, PXE network booting **216**, and iSCSI memory device **228**. In this case, the setup utility **204** has a unique signature of 0, the hard disk drive **0 208** has a unique signature of 1, USB memory device **224** has a unique signature of 2, PXE network booting **216** has a unique signature of 3, and iSCSI memory device **228** has a unique signature of 4. The setup utility **204** may be allocated to whatever position in the boot sequence as needed.

The ROM **116** further stores a setup utility timer value table **312** that includes a setup utility timer value essentially defined as: within the setup utility timer value, if a human interface device (HID) does not send any input, the setup utility **204** will execute an operation, for example, by means of the boot sequence table **308**, to determine whether there is any next bootable subject to be booted. Depending on the user's setting, the setup utility timer value determined includes but is not limited to 0 to 60 seconds and is set to 30 seconds in one embodiment, but the present invention is not limited thereto. Details of the boot sequence table **308** and the setup utility timer value table **312** and operation are further described below.

Referring to FIG. **4**, a process for booting the information processing system **100** shown in FIG. **1** through FIG. **3** according to an embodiment is illustrated. As shown in FIG. **4**, a process **600** for booting the information processing system includes a number of blocks. In block **604** a power supply (not shown) is started. Next, in block **608**, the CPU **110** accesses the boot sequence table **308** of the ROM **116** via the operating system firmware interface **117**. Then, in block **612**, the CPU **110** determines the subject of the intended apparatus boot in accordance with the boot sequence table **308**. Next, in decision block **616**, the CPU **110** determines whether the determined subject is a setup utility in accordance with the boot sequence table **308**.

If the CPU **110** determines that the determined subject is a setup utility, control transfers from block **616** to block **620**. In block **620** the CPU **110** starts the setup utility **204**. Next, in block **624**, the CPU **110** accesses the setup utility timer value table **312** of the ROM **116** via the operating system firmware interface **117**. Then, in decision block **628**, the CPU **110** determines whether the value of the setup utility timer value table **312** is zero. If the value is zero in block **628**, control transfers to block **632**, In block **632**, the information processing system **100** is idle and keeps waiting for a signal/input from at least a human interface apparatus.

If the value is not zero in block **628**, control transfers to block **636**. In block **636**, the CPU **110** determines whether there is not any signal/input from the at least a human interface apparatus within a specific time period of the value of the setup utility timer value table **312**. If the determination is affirmative, control transfers from block **636** to block **616**, where further processing is initiated on the next subject in the boot sequence table **308**. If the determination is negative (i.e., there is a signal/input (including but not limited to pressing one or more function keys manually) from at least a human interface apparatus within a specific time period of the value of the setup utility timer value table **312**) control transfers from block **636** to block **632** (i.e., the information processing system **100** is idle and waits for an input from the at least a human interface apparatus.

If the CPU **110** determines that the determined subject is not a setup utility in block **616**, control transfers from block **616** to block **640**. In block **640** the CPU **110** boots a subject determined not to be the setup utility **204**. Next, in decision block **644**, the CPU **110** determines whether the boot is successful. The process flow of the process **600** transfers to block **648** if the boot is successful. If the boot is unsuccessful, control transfers to block **616**, where the process is continued on the next subject in the boot sequence table **308**. If the boot is successful in block **644** control transfers to block **648**, where the CPU **110** boots the operating system **141**.

Subsequently, for example, a typical system operates or enters a standby state. For more information about the other basic architecture and components of the information processing system **100**, reference can be made to typical personal computers or servers, such as IBM's System X, Blade Center or eServer. Details irrelevant to the present invention are not described herein for the sake of brevity.

According to embodiments of the present disclosure, no user will fail to press function keys or enter a BIOS setup utility just because the user misses a prompt message. Furthermore, in case a boot failure happens to any apparatus, the system will enter a setup utility to examine the details of the failure conveniently in accordance with the user's configuration of the boot path. In the aforesaid embodiment, the operating system firmware interface is explained from the perspective of the BIOS; however, persons skilled in the art are able to infer easily additional situations, including but not limited to UEFI and EFI, but the present invention is not limited thereto. Furthermore, in the embodiment illustrated with FIG. **4**, the boot sequence table **308** illustrates a boot sequence: setup utility **204**, hard disk drive **0 208**, USB memory device **224**, PXE network booting **216**, and iSCSI memory device **228**; however, persons skilled in the art are able to readily infer additional apparatuses, situations, and combinations, as appropriate, wherein the setup utility **204** can be allocated to another position in the sequence, but the present invention is not limited thereto.

The present invention may be a system, a method, and/or a computer program product. The computer program product may include a computer readable storage medium (or media) having computer readable program instructions thereon for causing a processor to carry out aspects of the present invention.

The computer readable storage medium can be a tangible device that can retain and store instructions for use by an instruction execution device. The computer readable storage medium may be, for example, but is not limited to, an electronic storage device, a magnetic storage device, an optical storage device, an electromagnetic storage device, a semiconductor storage device, or any suitable combination of the foregoing. A non-exhaustive list of more specific examples of the computer readable storage medium includes the following: a portable computer diskette, a hard disk, a random access memory (RAM), a read-only memory (ROM), an erasable programmable read-only memory (EPROM or Flash memory), a static random access memory (SRAM), a portable compact disc read-only memory (CD-ROM), a digital versatile disk (DVD), a memory stick, a floppy disk, a mechanically encoded device such as punch-cards or raised structures in a groove having instructions recorded thereon, and any suitable combination of the foregoing. A computer readable storage medium, as used herein, is not to be construed as being transitory signals per se, such as radio waves or other freely propagating electromagnetic waves, electromagnetic waves propagating through a waveguide or other transmission media (e.g., light pulses passing through a fiber-optic cable), or electrical signals transmitted through a wire.

Computer readable program instructions described herein can be downloaded to respective computing/processing devices from a computer readable storage medium or to an external computer or external storage device via a network, for example, the Internet, a local area network, a wide area network and/or a wireless network. The network may comprise copper transmission cables, optical transmission fibers, wireless transmission, routers, firewalls, switches, gateway computers and/or edge servers. A network adapter card or network interface in each computing/processing device receives computer readable program instructions from the network and forwards the computer readable program instructions for storage in a computer readable storage medium within the respective computing/processing device.

Computer readable program instructions for carrying out operations of the present invention may be assembler instructions, instruction-set-architecture (ISA) instructions, machine instructions, machine dependent instructions, microcode, firmware instructions, state-setting data, or either source code or object code written in any combination of one or more programming languages, including an object oriented programming language such as Smalltalk, C++ or the like, and conventional procedural programming languages, such as the "C" programming language or similar programming languages. The computer readable program instructions may execute entirely on the user's computer, partly on the user's computer, as a stand-alone software package, partly on the user's computer and partly on a remote computer or entirely on the remote computer or server. In the latter scenario, the remote computer may be connected to the user's computer through any type of network, including a local area network (LAN) or a wide area network (WAN), or the connection may be made to an external computer (for example, through the Internet using an Internet Service Provider). In some embodiments, electronic circuitry including, for example, programmable logic circuitry, field-programmable gate arrays (FPGA), or programmable logic arrays (PLA) may execute the computer readable program instructions by utilizing state information of the computer readable program instructions to personalize the electronic circuitry, in order to perform aspects of the present invention.

Aspects of the present invention are described herein with reference to flowchart illustrations and/or block diagrams of methods, apparatus (systems), and computer program products according to embodiments of the invention. It will be understood that each block of the flowchart illustrations and/or block diagrams, and combinations of blocks in the flowchart illustrations and/or block diagrams, can be implemented by computer readable program instructions.

These computer readable program instructions may be provided to a processor of a general purpose computer, special purpose computer, or other programmable data processing apparatus to produce a machine, such that the instructions, which execute via the processor of the computer or other programmable data processing apparatus, create means for implementing the functions/acts specified in the flowchart and/or block diagram block or blocks. These computer readable program instructions may also be stored in a computer readable storage medium that can direct a computer, a programmable data processing apparatus, and/or other devices to function in a particular manner, such that the computer readable storage medium having instructions stored therein comprises an article of manufacture including instructions which implement aspects of the function/act specified in the flowchart and/or block diagram block or blocks.

The computer readable program instructions may also be loaded onto a computer, other programmable data processing apparatus, or other device to cause a series of operational steps to be performed on the computer, other programmable apparatus or other device to produce a computer implemented process, such that the instructions which execute on the computer, other programmable apparatus, or other device implement the functions/acts specified in the flowchart and/or block diagram block or blocks.

The flowchart and block diagrams in the Figures illustrate the architecture, functionality, and operation of possible implementations of systems, methods, and computer program products according to various embodiments of the present invention. In this regard, each block in the flowchart or block diagrams may represent a module, segment, or portion of instructions, which comprises one or more executable instructions for implementing the specified logical function (s). In some alternative implementations, the functions noted in the block may occur out of the order noted in the figures. For example, two blocks shown in succession may, in fact, be executed substantially concurrently, or the blocks may sometimes be executed in the reverse order, depending upon the functionality involved. It will also be noted that each block of the block diagrams and/or flowchart illustration, and combinations of blocks in the block diagrams and/or flowchart illustration, can be implemented by special purpose hardware-based systems that perform the specified functions or acts or carry out combinations of special purpose hardware and computer instructions.

While the invention has been described with reference to exemplary embodiments, it will be understood by those skilled in the art that various changes may be made and equivalents may be substituted for elements thereof without departing from the scope of the invention. In addition, many

modifications may be made to adapt a particular system, device or component thereof to the teachings of the invention without departing from the essential scope thereof. Therefore, it is intended that the invention not be limited to the particular embodiments disclosed for carrying out this invention, but that the invention will include all embodiments falling within the scope of the appended claims. Moreover, the use of the terms first, second, etc. do not denote any order or importance, but rather the terms first, second, etc. are used to distinguish one element from another.

The terminology used herein is for the purpose of describing particular embodiments only and is not intended to be limiting of the invention. As used herein, the singular forms "a", "an" and "the" are intended to include the plural forms as well, unless the context clearly indicates otherwise. It will be further understood that the terms "comprises" and/or "comprising," when used in this specification, specify the presence of stated features, integers, steps, operations, elements, and/or components, but do not preclude the presence or addition of one or more other features, integers, steps, operations, elements, components, and/or groups thereof

The corresponding structures, materials, acts, and equivalents of all means or step plus function elements in the claims below, if any, are intended to include any structure, material, or act for performing the function in combination with other claimed elements as specifically claimed. The description of the present invention has been presented for purposes of illustration and description, but is not intended to be exhaustive or limited to the invention in the form disclosed. Many modifications and variations will be apparent to those of ordinary skill in the art without departing from the scope and spirit of the invention. The embodiments were chosen and described in order to best explain the principles of the invention and the practical application, and to enable others of ordinary skill in the art to understand the invention for various embodiments with various modifications as are suited to the particular use contemplated.

What is claimed is:

1. A method comprising:

by computer program instructions on a computing device,
- storing a boot sequence table in the storage unit, wherein the boot sequence table includes a specific boot sequence defining a boot sequence of the setup utility and the bootable subject during booting;
- starting a setup utility in response to the determining that the subject to be booted, in accordance with the boot sequence, is the setup utility;
- starting a setup utility timer value countdown from a specific value; and
- determining whether an input is received from a human interface apparatus before the setup utility value completes the countdown;
- if no input is received from the human interface apparatus before the setup utility value completes the countdown, restarting the setup utility; and
- if an input is received from the human interface apparatus before the setup utility value completes the countdown, keeping the information processing system idle and waiting for an additional input from the human interface apparatus.

2. The method of claim **1**, further comprising:

accessing the setup utility timer value table via the operating system firmware interface.

3. The method of claim **1**, wherein the operating system firmware interface comprises one of a basic input/output system (BIOS), a universal extensible firmware interface (UEFI), and an extensible firmware interface (EFI).

4. The method of claim **1**, further comprising accessing an instruction from the operating system firmware interface to boot an operating system.

5. The method of claim **1**, wherein the bootable subject comprises at least one of a hard disk drive **0**, a hard disk drive **1**, a preboot execution environment (PXE) network booting, a compact disc/digital versatile disk (CD/DVD), a universal serial bus (USB) memory device, and an Internet small computer system interface (iSCSI) memory device.

6. An apparatus for booting an information processing system, the information processing system comprising:

a processor;

a storage unit electrically coupled to the processor and including an operating system firmware interface and a setup utility; wherein the storage unit includes computer program instructions that when executed by the processor cause the apparatus to:

store a boot sequence table in the storage unit, wherein the boot sequence table includes a specific boot sequence defining a boot sequence of the setup utility and the bootable subject during booting;

start a setup utility in response to the determining that the subject to be booted, in accordance with the boot sequence, is the setup utility;

start a setup utility timer value countdown from a specific value; and

determining whether an input is received from a human interface apparatus before the setup utility value completes the countdown;

if no input is received from the human interface apparatus before the setup utility value completes the countdown, restart the setup utility; and

if an input is received from the human interface apparatus before the setup utility value completes the countdown, keep the information processing system idle and waiting for an additional input from the human interface apparatus.

7. The apparatus of claim **6**, wherein the processor accesses the setup utility timer value table via an operating system firmware interface.

8. The apparatus of claim **6**, wherein the operating system firmware interface comprises one of a basic input/output system (BIOS), a universal extensible firmware interface (UEFI), and an extensible firmware interface (EFI) and the bootable subject comprises at least one of a hard disk drive **0**, a hard disk drive **1**, a preboot execution environment (PXE) network hooting, a compact disc/digital versatile disk (CD/DVD), a universal serial bus (USB) memory device, and an Internet small computer system interface (iSCSI) memory device.

9. The apparatus of claim **6**, wherein the processor accesses an instruction from the operating system firmware interface to boot an operating system.

10. A computer program product comprising: a non-transitory computer readable storage medium that includes computer program instructions that when executed by a processor cause the processor to:

store a boot sequence table in the storage unit, wherein the boot sequence table includes a specific boot sequence defining a boot sequence of the setup utility and the bootable subject during booting;

start a setup utility in response to the determining that the subject to be booted, in accordance with the boot sequence, is the setup utility;

start a setup utility timer value countdown from a specific value; and

determining whether an input is received from a human interface apparatus before the setup utility value completes the countdown;

if no input is received from the human interface apparatus before the setup utility value completes the countdown, restart the setup utility; and

if an input is received from the human interface apparatus before the setup utility value completes the countdown, keep the information processing system idle and waiting for an additional input from the human interface apparatus.

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